

Inadequate Medical Order Writing

A Source of Confusion and Increased Costs

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Audits of medication and intravenous fluid orders and of return to the pharmacy of unused intravenous solutions were conducted in 1980 at a university teaching hospital in response to a prevailing impression among pharmacists that physicians' orders were often written in an incomplete, nonstandardized fashion and that intravenous fluid wastage was common. A disturbing number of orders were incomplete and judged to be ambiguous. Less than 25% of orders for intravenously given solutions contained adequate instructions for subsequent administration of fluids. Intravenous fluid return amounted to an estimated loss of \$137,695 per year in wasted material and labor.

The results of the audits were disseminated among the staff. In addition, the pharmacy changed its operations to detect more quickly and correct the problems caused by ambiguous orders. Later studies showed a reduction in the return of unused intravenous fluids and some improvement in order writing. Inadequate and ambiguous orders were still judged to be a problem, however, especially intravenous fluid orders that omitted instructions for subsequent fluid requirements and "open-ended" intravenous fluid orders. Such orders were eight times more likely to be associated with return of unused intravenous fluids than orders with adequate instructions for giving fluids subsequently.

An important source of rising health care costs is inefficiency in the use of so-called little ticket technologies.¹ "Little ticket" refers to the thousands of tests and procedures that are used most frequently by physicians and that individually cost little. By contrast, a "big ticket" technology such as computerized tomographic scanning is very expensive and, therefore, attracts a great deal of attention. According to Moloney and Rogers,¹ however, the "big tickets" account for far less of the escalating cost of medical care than do the cumulative costs of "little ticket" activities common to everyday medical practice.

Hospital costs account for a substantial portion of all personal health care expenditures. In 1981 hospital costs amounted to \$112.3 billion out of the \$278.5 billion spent for personal health care in the United States.² In hospital, big and little ticket technologies are administered through a variety of means, one of which is a physician's order.

The process of medical order writing is an instrumentally important activity for using hospital resources, especially drugs and intravenously given fluids. In our hospital, charges for pharmacy services accounted for 5.4% of patient charges in 1981. Nationwide in 1981 \$20.6 billion were spent on drugs and medical sundries (inpatient and outpatient).² Thus, we were concerned when pharmacists noted that orders for drugs and intravenous fluids were often incomplete and ambiguous. They also suspected that substantial amounts of intravenous fluids were returned unused to the pharmacy, possibly as a consequence of inadequate, nonstandardized orders. Because of this prevailing impression, an audit was done in 1980 to assess the quality of medication and intravenous orders and to determine the amount of return and waste of intravenous solutions. The results of the original 1980 studies led to changes in pharmacy policy and to follow-up studies of the quality of order writing and the "causes" of intravenous

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fluid wastage. The follow-up studies showed a reduction in the losses due to wasted materials. Herein we describe our studies of this "little ticket" activity that is of great importance to the efficient operation of a modern hospital.

Methods

The process of order writing and delivery consists of at least the following four phases:

1. *Order writing.* A physician writes an order.
2. *Charting and distribution.* A ward clerk notes the order and distributes it to nursing and pharmacy departments, where it is reviewed and filed in the respective patient's chart.
3. *Preparation and delivery.* A centrally based pharmacist prepares or obtains the medication or intravenous solution ordered and has it delivered to the nursing unit.
4. *Administration.* Nursing staff administers medication and intravenous fluids to the patient.

Although problems may arise in any phase, we studied the first and fourth elements of this process: medication order writing and whether intravenous fluids were administered or returned unused, a short-term outcome of the entire process.

Criteria for the adequacy of a medication order were established by a group comprised of two physicians, a nurse and a pharmacist. The group selected a set of criteria designed to yield an order that was unambiguous, that could be acted upon with the least possibility of error and that could be prepared without delays or extra steps required, such as telephone calls for clarification. Another goal of the criteria was that adequate orders would not be a source of waste. The criteria specified that each medication order should include the following elements: (1) medicine—the generic name is specified and is unabbreviated; (2) dose; (3) route of administration; (4) frequency of administration, and (5) whether or not the order is a PRN (*pro re nata*, "according to circumstances" or "as needed") order. Criteria for orders for intravenous solutions were similar, specifically that an order should contain the following elements: (1) solution name, (2) volume of solution, (3) concentration of additives, (4) rate of administration and (5) orders for subsequent fluids.

Statistics were also kept on other elements that the group felt were necessary for completeness and for efficient pharmacy operations including whether or not the date and time of the order and location of the patient were given and the legibility of the signature. Because these elements were not formal criteria, orders that did not meet these criteria were not reviewed separately.

The order-writing sample consisted of all medication and intravenous fluid orders written during a randomly selected 24-hour period in 1980 and in 1981. The 24-hour period selected for study was unknown to members of the hospital staff, except those doing the study. The orders were reviewed by trained abstractors

TABLE 1.—Compliance With Adequacy Criteria of Physicians' Written Orders

Adequacy Criteria	Rate of Compliance	
	1980 Percent	1981 Percent
Medication (n=639)		(n=865)
Dose given	93.6	92.7
Route of administration given	88.1	90.0
Frequency stated	87.8	87.9
Indication for PRN order	54.0* (n=226)	83.0* (n=276)
Intravenous Fluids (n=75)		(n=119)
Name of solution given	94.7	92.4
Volume stated	52.0	37.0
Rate of infusion given	84.0	87.4
Instructions for subsequent administration of fluids included	24.0	28.6

PRN=*pro re nata*, "according to circumstances" or "as needed."

* $P < .001$ by χ^2 .

for compliance with the above criteria. Each order that did not meet the criteria was reviewed by two physicians and a pharmacist to determine if it was ambiguous, might cause errors or delays and might lead to waste.

The return of unused intravenous (IV) fluids was determined by keeping a record of all intravenous solutions returned unused to the pharmacy for 72-hour periods. The original study of IV fluid return (March 5 through 7, 1980) was supplemented by two follow-up studies after the pharmacy changed operations. A restudy of return was done in 1981, about a year after the original audit. Costs associated with intravenous solutions were calculated on the basis of the actual cost to the pharmacy of materials not used and the cost of preparation time. To calculate the cost of preparation time, we observed the time required to prepare intravenous solutions and, based on the pharmacists' wages, the cost of time spent preparing solutions that were unused. Average preparation times were 5 minutes per intravenous solution order, 2.5 minutes for "piggyback" intravenous solutions (a medication preformulated in a 25- to 100-ml container, which is then connected to an already running intravenous solution bottle) and 40 minutes for a total parenteral nutrition solution. Costs were calculated on the basis of 1980 material costs and wages. The 1981 restudy of unused intravenous fluid included a detailed analysis of the reasons for return of the fluids. The type of order and the reason the fluid was returned unused to the pharmacy were determined by reviewing the circumstances associated with each unit of solution returned. Comparisons were tested for statistical significance using the χ^2 test and Yates' continuity correction.³

Results

In all, 725 medication orders (including 86 "stop" orders) were written during a 24-hour study period in 1980 and 967 (including 102 "stop" orders) in 1981. A substantial number of orders did not meet the study criterion of containing an unabbreviated generic name

(57.4% in 1980, 50.6% in 1981). Reviewers did not consider this a source of confusion, however, except when abbreviations or other ambiguous names were used. Examples included: "iron," "chloro" and "tyl."

Table 1 shows the rates of compliance with order-writing criteria for the initial medication and intravenous fluid orders. Orders written without a specific dose were not a major problem because 90.2% (37 of 41) either were available in only one dosage form or the dose could be determined from previous orders or written intensive-care-unit protocols. Of about 10% of medication orders not stating route of administration, 52.6% involved drugs in which different routes are possible and the orders were therefore ambiguous. Examples encountered included heparin, furosemide, diazepam, morphine sulfate, meperidine hydrochloride, propranolol and potassium chloride.

Physicians reviewing noncompliant orders and selected charts found no evidence that orders that did not specify frequency resulted in adverse outcomes to patients. However, such orders did transfer interpretation and decision making to nursing staff, posed problems for the pharmacy filling these orders and increased the likelihood of error. Almost half of the PRN orders analyzed in the 1980 study did not state the indications for need. The reviewers noted instances when PRN orders were ambiguous because the medication might have various indications. Examples included orders for diazepam in patients with seizures and those for acetaminophen in neutropenic patients receiving cancer chemotherapy.

Table 1 also shows that orders for intravenous fluids written during the same 24-hour period often did not meet the criteria for an adequate IV order. The inadequacies, taken individually or as a whole, were judged to create ambiguities for both nurses and pharmacists. Orders that did not specify volume created a major problem when they included an additive, which made the desired concentration indeterminate. Orders that did not state the rate of flow caused difficulty both for pharmacists who prepared and delivered the solutions and for nurses who administered them.

The frequency with which an order for subsequent administering of IV fluids was stated was only 24% in 1980 and 28.6% in 1981 (Table 1). In our hospital, the absence of specific instructions for subsequent administration of fluids is a major problem and a source of waste, because intravenous solutions are formulated in the pharmacy, not on the wards. Any order without a "to follow" instruction is assumed to be a continuous order—that is, to be continued indefinitely until a discontinue order is written. The high frequency of orders without specific instructions for subsequent intravenous administration of fluids was considered to be a serious problem detected by this study and an important cause of the return of unused IV solutions to pharmacy.

In the 1980 audit, the high frequency of illegibility of signatures and of orders in which the nursing unit was not stated (Table 2) was judged by reviewers to create problems, especially when ambiguous orders

TABLE 2.—Items That Contribute to Efficiency of Medication and Intravenous Fluid Orders

Miscellaneous Items	Rate of Compliance	
	1980 (n=300) Percent	1981 (n=429) Percent
Signature legible	49.0*	82.1*
Date given	85.3	90.0
Time given	20.7	31.0
Nursing unit stated	83.6*	98.8*

* $P < .001$ by χ^2 .

TABLE 3.—Description of Intravenous Solutions Returned to Pharmacy Unused*

	1980 Number (Percent)†	1981 Number (Percent)†
Intravenous solutions returned per day	50.0 (46.7)‡	25.7 (26.6)‡
Piggyback intravenous solutions returned per day	47.0 (18.4)§	20.3 (9.5)§
TPN solutions returned per day	1.0 (3.7)	0.3 (1.5)
Cost per day of material . . .	\$302	\$135
Preparation time per day (hours)	6.8	3.1
Estimated cost per year of wasted material and labor	\$137,695	\$63,488

TPN = total parenteral nutrition.

*Based on a 72-hour period in 1980 and a 120-hour period in 1981.

†IV's returned per day $\times 100$

‡IV's prepared per day

‡ $P < .001$ by χ^2 .

§ $P < .01$ by χ^2 .

were received and a pharmacist must attempt to find the physician or the origin of that order. In the 1981 audit, signatures were more frequently legible (P less than .001) and the nursing unit was noted on virtually all orders.

The results of our 1980 audit of IV solution return and waste and the 1981 restudy are shown in Table 3. During the 1980 study period, 46.7% of 321 IV solutions prepared in a three-day period were returned, 18.4% of 766 piggyback intravenous solutions and only 3.7% of 81 total parenteral nutrition solutions. Using patient-bed days as a denominator, 0.32 intravenous solution units per patient-bed day were returned during this survey period.

The enormous cost of wasted material and effort (Table 3) was of great concern to members of pharmacy and the medical staff. The results of these 1980 studies were circulated to medical staff, house staff and pharmacy staff.

After the audit results were disseminated, the pharmacy changed its operation to decrease the amount of time a problem perpetuates itself due to ambiguous information or lack of information. Specifically, IV solutions are now prepared four times a day instead of once a day. Before intravenous solution units are sent to a floor (five times per day), the admission, discharge and transfer information sheets are checked. Every delivery made by pharmacy technicians now includes a check for discontinued solutions and the accumulation of piggyback intravenous bottles on the ward so that

TABLE 4.—*Some Causes of Return of Unused Intravenous Solutions*

	Number (n = 231)	Percent
Manner in which intravenous solution order is written	64	27.7
Manner in which order is interpreted or acted upon on the ward	94	40.7
Manner in which pharmacy acts on orders .	37	16.0
Admission-discharge transfer problems	19	8.2
Indeterminate	17	7.4

when an intravenous solution regimen is discontinued, the pharmacy is informed sooner. (Formerly the pharmacy computer continued to print labels until the pharmacy was notified that an order had been discontinued.)

In two follow-up surveys in 1980 (not displayed in the table) we recorded a progressive reduction in the return of intravenous solutions. A month after the pharmacy changed its operations, 34.0% of IV solutions, 8.0% of piggyback intravenous bottles and 2.8% of total parenteral nutrition solutions were returned. A survey one month later found that 20% of intravenous solutions and 8.0% of piggyback IV units were returned per day.

In 1981, about a year after the original study, we restudied the frequency of return of intravenous preparations. As shown in Table 3, the reduction observed in 1980 persisted, but substantial amounts of IV fluids were still being returned unused to the pharmacy. In the 1981 study, 0.16 intravenous fluid units per patient-bed day were returned unused.

The 1981 IV return study included a more detailed analysis of 231 intravenous fluid units returned during a five-day period (Table 4). The specific cause for return of intravenous solutions could be determined for 92.6% of all those returned; in 27.7% the cause for the unused IV fluid return was considered directly related to the manner in which the order was written. When IV return was related to actions that occurred on the ward (94 instances), the most common reason was that the IV solution was not given as ordered (27 instances). Of 37 intravenous solution units returned due to pharmacy-related causes, 24 were related to the pharmacy's intravenous fluids delivery schedule. Of the orders associated with solutions returned unused, 96.6% did not contain adequate instruction for giving subsequent fluids. Of orders without adequate instructions for subsequent fluids, 81.2% were "open-ended."

Discussion

Our findings were that medication orders and orders for intravenously given fluids were frequently incomplete. Incomplete orders are ambiguous and typically lead to an error in medication administration, require time-consuming telephone calls for clarification or simply transfer patient-care decision making to non-physicians. Incomplete and ambiguous orders create

special problems for pharmacists who formulate and prepare orders centrally, especially when they have difficulty locating the physician who wrote the order.

The enormity of IV solution waste was surprising. Because we could find no reports of the magnitude of return of unused intravenous preparations in other institutions, it was not possible to determine whether or not our hospital was unusual. Nonetheless, the estimated loss was considerable and amounted to more than 20% of the pharmacy's 1980 intravenous solution budget.

The inefficiency in our system appeared to be reduced when the pharmacy's operation was changed to quickly respond to changes in patient intravenous fluid requirements even in the absence of a correctly written order. The changes probably reduced waste simply by decreasing the amount of time a problem perpetuates itself. The changes involved restructuring pharmacy staff work procedures and did not result in added staff or costs. Despite these changes, however, waste of intravenous fluids still occurs.

The reasons for IV solution return and waste are complex. In the 1981 study we identified 19 different causes for return of intravenous fluids, suggesting that a certain amount of waste is inevitable given the changing needs of patients and the complexity of a modern hospital. A prominent cause of special relevance to physicians was the open-ended IV order. In this study, an order written without instructions for subsequent intravenous administration of fluids was more than eight times more likely to be returned than an order that included such instructions, suggesting that more careful order writing would reduce the waste. We believe that intravenous fluid orders should be written for only a 24-hour period. A good system is to number each intravenous solution bottle ordered as follows:

- 1,000 ml of normal saline at 125 ml per hour.
- 1,000 ml of 5% dextrose in half normal saline at 125 ml per hour.
- 1,000 ml of 5% dextrose in half normal saline at 50 ml per hour.

For continuous infusion of the same solution, the duration of the infusion should be described and reordered every 24 or, at most, 48 hours. In our 1981 audit, only 4 (1.7%) of 231 IV solutions returned were ordered with those instructions. Return of unused preparations in these instances was related to unanticipated changes in patient status, an uncontrollable factor.

Most literature on medication orders and prescriptions has focused on medication errors,^{4,5} illegibility of physician handwriting⁶ and errors in physicians' prescriptions.⁷ Our study assessed a large number of orders and found that many were incomplete. Incomplete and ambiguous orders are a source of medication error.⁴ They are also a source of inefficiency when they lead to time-consuming telephone calls for clarification. Our findings, and the findings of others,⁴⁻⁷ suggest that physicians, perhaps because other aspects of patient care seem to be more important, too frequently ap-

proach order writing with a casual attitude. This and any subsequent inadequacies may relate to the fact that schools and training programs typically do not systematically instruct trainees in this topic or emphasize the importance of careful order writing. Instruction usually occurs on the wards and is not standardized.

We hope that our findings will stimulate others to further investigate order writing and related topics like return and waste of intravenous solutions to determine if the findings are unique or generalizable. Most important, we hope that they will prompt physicians to exercise more care in writing orders and to educate students and physicians-in-training to approach order writing in a careful, systematic fashion.⁸ A more careful

approach to order writing should improve patient care and help eliminate excess health care costs associated with a physician activity that is extremely important for the efficient operation of a modern hospital.

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Medical Practice Questions

EDITOR'S NOTE: From time to time medical practice questions from organizations with a legitimate interest in the information are referred to the Scientific Board by the Quality Care Review Commission of the California Medical Association. The opinions offered are based on training, experience and literature reviewed by specialists. These opinions are, however, informational only and should not be interpreted as directives, instructions or policy statements.

Collagen Implants

QUESTION:

Are collagen implants considered accepted medical treatment or are they investigational?

OPINION:

In the opinion of the Scientific Advisory Panels on Dermatology and Plastic Surgery, collagen implants are considered established medical practice for the treatment of contour defects of the skin.

Collagen implant treatments have been used primarily for cosmetic reasons. The experience to date suggests the preparation is safe and useful for the temporary correction of superficial scarring resulting from acne, chickenpox, excoriations and wrinkling, in certain areas of the face. Repeated treatments are frequently necessary. The duration of the cosmetic effect is not known because of insufficient long-term experience with the preparation.

Selection of the patient requires good judgment. Clear indications for the optimal use of collagen implants and their long-term potential for allergenicity are still to be established.